3 What Is Perspectivism, and Does It Count as Realism?

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1 Giere's Perspectivism

Broadly, perspectivism is the view that human knowledge is unavoidably from a particular perspective or vantage point. Such ideas have resonated throughout the history of philosophy, for example, in the work of Leibniz, Kant, and Nietzsche, and in the contemporary work of some philosophers, such as Putnam and Nagel. Nancy Cartwright (1983) and Ronald Giere (1985) launched a line of work that looks at science not as an enterprise of finding true laws but one of constructing inexact models. They did not use the metaphor of perspectives, but their approach has been deeply perspectivist. Models are always simplifications, different ones working well for different explanatory and practical objectives.

Giere (2006) explicitly casts this line of work in the perspectivist metaphor, urging also that this perspectivism should count as a form of scientific realism. He begins (chapter 2) with the illustration of color vision. We are trichromats, thereby having a "colored perspective" on the world that differs from those of di- and tetrachromats. Giere then argues (chapter 3) that this understanding generalizes to observation with scientific instruments. The "perspective" that governs a measurement with an instrument is the collection of assumptions about the functioning of the instrument and of the theory used in interpretation of the instrument's output. Why does this count as a "perspective"? A measurement outcome is only secure insofar as these assumptions obtain. In particular, the measurement outcome can be safely used only to the extent that these assumptions apply or can be taken for granted. In this sense, measurement outcomes cannot be detached from the perspective within which they were obtained. In addition, no measurement perspective is unique because each involves imperfect idealizations.[1] These conclusions apply equally to scientific observations made without instruments because of the commonplace that, to be useful, even observations made without instruments have to be theoretically interpreted.

Turning to theoretical claims (chapter 4), Giere argues that in formulating theories scientists "create perspectives within which to conceive

of aspects of the world" (59). Following the case of observation with instruments, a theoretical perspective is constituted by the assumptions of a theory. For the same reasons that applied in the case of observation, all claims made within a theory are undetachable from the perspective constituted by the theory.

Natural questions arise about Giere's perspectivism, as I have so far summarized it. Often a claim made in one perspective/theory can be used in a context governed by a different perspective. Perspectives can be combined, but "[m]ultiplying perspectives does not eliminate perspectives" (92). The only sort of perspective-free claim that one can legitimately make is the conditional, with a description of the perspective as antecedent and measurement outcome or theoretical claim as consequent, and even such claims will be from some (presumably very broad) perspective.

Objection! One can use tables such as that of the National Institute of Standards and Technology to look up physical constants and use them just anywhere. Not really. Giere will say: to use these one must be skilled in their use, involving understanding of their theoretical meaning and the theoretical contexts in which they can be applied. Take the following example: the mass of an electron = $9.10938356 \times 10^{-31}$ kg. Theoretically, the rest mass of an object isn't even a constant. It varies with the "impact parameter" with which it is measured. One has to know whether and, if so, how to take such complications into account. One also has to have a theoretical understanding of the unit of measure, the kilogram.

Giere claims that, although all scientific claims are from within a perspective, such claims count as a kind of realism when the perspective in question and the way it has been used meet high standards of scientific practice. Why? All that Giere tells us is that such are "the most reliable conclusions any human enterprise can produce" (92). I think that the intended argument goes something like the following: Giere has acknowledged (chapter 1) that such conclusions are in part contingent on human needs, interests, and historical accidents, since these affect our fashioning of details of our theories. But the reliability of our theories is also very heavily contingent on "the world," that is, on circumstances utterly beyond our control. Moreover, scientific standards insure that when accepted, such perspectival claims are still very robust. They will stand up in a wide range of relevant circumstances. They can be combined with cognate perspectives to expand our store of (still always perspectival) knowledge. In these senses, conclusions that meet high scientific standards are "telling us something about the world." This is the best—really the only—kind of knowledge of the world we can have. This is the most one could ask of a realist attitude. I don't think Giere has more than this to offer and, yes, so far the argument is thin. Below I will very extensively enlarge on such considerations as supporting the label "realism."

2 Scientific Realism as Referential Realism

One consideration that, in combination with others, will favor perspectival realism will be that standard scientific realism fails. I will work with a "generic" formulation of standard scientific realism, following common elements of two standard sources (Psillos 1999, xix ff.; Chakravartty 2017, sec. 1.2).

In the first instance, a scientific realist wants to say that our "mature" theories get it right about the world, that is, that they offer important claims that are true. Recognizing that, broadly, even our best theories are simplifications or idealizations, the claim of truth is, brushing aside worries about what it is to be approximately true, qualified as approximate truth.[2] But to realists, well-established existence claims seem unproblematically and not just approximately true. Indeed, what would it mean for a claim of existence of a thing or kind of thing to be "close to the truth"? Either there is that thing, or kind of thing, or there is not! (This issue will come in for closer examination below.)

It is useful to reformulate this generic statement. The canonical example is the claim that there are atoms. Instead of claiming that there are atoms, one can reformulate this material mode statement in the formal mode and say that "atom" has a non-empty extension. Generalizing on this example yields what I call "referential realism":

> *Referential realism*: Many important terms in mature scientific theories have non-empty extensions, and the theories in which they occur, at least often, provide approximately true claims about the things in these extensions.

Standard scientific realism is or includes referential realism as a principal component.[3,4] The point of my reformulation is that it will make apparent options that are otherwise not apparent.

To see what is involved in referential realism, I will appeal to what I call "the tools of reference." First, there are referring terms that, when things go well, we take to have specific referents. "The Eiffel Tower" refers to the Eiffel Tower. "The standard kilogram" refers to the standard kilogram.[5] "Temperature" refers to the quantity temperature. Next, there are predicates (understood also to include kind terms and relational terms), which, when things go well, we take to have specific extensions: for "atom," the collection of all atoms; for "cell" (disambiguated to the intended biological kind), the collection of all cells; for "chair," the collection of all chairs. (I include the problematic example of "chair" to foreshadow the fundamental point soon to come.)

How do predicates get attached to their extensions? This cannot be directly, for then a predicate's extension could not change and we

could not reason counterfactually about such extensions (what if there were more or different kinds of atoms . . .). Instead, for each predicate there must be some mediating consideration, what I will refer to as an extension-determining characteristic, to which the predicate is attached or with which it is associated, so that something is in the predicate's extension just in case it has that characteristic. These characteristics might be properties, qualities, attributes, kinds, conditions, and so forth. What I will need here is only that these characteristics determine what things go into an extension. Otherwise I needn't take a stand on just what these characteristics are or how they get attached to predicates. Thus, my characterization of the "tools of reference" covers a vast range of "theories of reference," all of which seek to characterize how the presumed tools of reference get attached to their referents and extensions. Finally, the package includes the applicability of strict identity. If *a* and *b* have referents, then there is always a fact of the matter, whether or not $a = b$ (recall Quine on this point: "No entity without identity!"). And for each extension of a predicate and each entity, there is a fact of the matter whether or not the entity is in the extension; equivalently, whether or not the entity has the characteristic associated with the predicate in question. Referential realism, as I intend it, is to be understood in terms of these referential tools.

Once the role of the tools of reference has been made explicit, we see that there are two ways in which some specific claim of realism could fail. Using the example of atoms, it could be that the term "atom" has been successfully attached to an extension-determining characteristic, but that extension is empty. "Magnetic monopoles" might be an example of such failure. Or the term may never have been successfully attached to any extension-determining characteristic. Note that this could be, not because there are no candidate characteristics to be attached, but because there are *too many* characteristics with failure to have picked out exactly one of them. We will see that, in the first instance, this is what appears to happen for "atom."

3 Referential Realism Fails

The underlying problem is that, given human limitations, the world is too complicated for our theoretical terms to get attached to any extension-determining characteristics.[6] The easy case is atoms. Are ions atoms? If yes, then bare nuclei would count as atoms. If no, then salt, held together by ionic bonds, is not composed of atoms. In the case of covalent bonds, quantum chemists start with the nuclei in a molecule as a "backbone" and then estimate properties of the "electron cloud" that envelops this backbone. Woody concludes (2010, 427) that when seen through such techniques, "any reliance upon the concept of the isolated atom in developing molecular wavefunctions was gone."

Borderline plasmas provide another example. In a plasma there is enough energy to completely dissociate electrons from nuclei. Presumably there are no atoms in a plasma. But as the temperature of a gas rises, approaching that for a plasma state, the process will be incomplete, and there will be a quantum mechanical superposition of atoms, incompletely ionized states in which atoms have lost some of their electrons, and states with nuclei completely stripped of electrons. In such a state, it will be indefinite just which parts count as atoms.

Note that what I have so far argued is not that there are no candidates for the needed extension-determining characteristic to function for the term "atom," but that there are too many. This makes room for the following response to the difficulty that I have raised for referential realism. Let us grant that we use "atom" loosely so that, strictly speaking, it does not have a well-characterized non-empty extension. But this loose use can easily be tidied up. What actually exist are things like ions, complexes of nuclei and electrons in covalently bonded molecules, nuclei and electrons in plasmas, and so on.

But when we get to the puzzles of quantum theory all of this becomes, at the very best, uncertain. Nuclei are composed of quarks and gluons, and functioning as they do in vast quantum mechanical superpositions makes it dubious whether "quark" and "gluon" have specific extensions at any one time. Electrons likewise coexist in superpositions with positrons in pair creation and annihilation.[7]

The case of atoms illustrates the kind of problem that I have in mind. But the problems are ubiquitous. The sorts of complications that arise for water chemistry will compromise specific extensions for molecules, at least in many cases. For things larger than molecules, there will be the same problems that arise for objects of perception that I will examine below. But for starters, just what is the extension of "chair" supposed to be? Though less extreme, the same sort of problem arises for predicates such as "cell."

The obvious retort to these worries is: so much the worse for the tools of reference! Bear in mind that "the tools of reference" is an umbrella notion that covers any in the family of accounts that work in terms of reference and extension-fixing characteristics, however "characteristics" is more specifically understood and these characteristics come to be associated with their predicates. The natural alternative is the family of "use" accounts, stemming from Wittgenstein's "the meaning of a word is its use in the language," according to which one must look to see how a term is used in a language community. Often such use accounts are distressingly non-specific.

What about cluster concept accounts? If the cluster in question is fixed, this is just another kind of characteristic and falls under the tools of reference umbrella. If the cluster is open-ended, somehow to be used at the discretion of language users, this will fall under the use family.

A second worry. Obviously, the tools of reference function for us somehow extremely successfully. So when I argue that the tools of reference fail to function as described, many readers will feel sure that something must have gone wrong.

No one gives up an account when problems are pointed out unless presented with an alternative account that meets at least some of the difficulties and that enables one to see how the old account worked as well as it did. So I must respond to this worry by introducing my alternative. We use the tools of reference, with great success, by using them in idealized models or similar arrangements.[8] Speaking metaphorically, in the world described by an idealized model, the referring terms and predicates *do* have referents and non-empty extensions. And in fortunate cases, in the real world such models function for us extremely well. In certain respects, this makes my approach a member of the use family. But my approach differs entirely from familiar versions of use accounts. These are supposed to work by looking at the patterns of use in a language community. My account instead looks at whether and to what extent an idealized use of a referential term functions for us successfully in respects that we care about. This makes my approach also very non-specific in a certain sense, but in a way that, I submit, is appropriate. My way of thinking about use of referential terms gives the *form* of answers to questions about how the term works. More specific answers to questions about success of an idealized use have to be answered case by case by examining just how a specific idealization, or a family of idealizations, functions.

The argument for my alternative account will be that it makes sense of the successful functioning of our use of the tools of reference in the face of the difficulties that I have explained. In particular, my examples will illustrate how taking the tools of reference to function through their use in idealizations simply sidesteps the difficulties.

Now to address a third anticipated complaint: the problems I have enumerated are just problems of imprecision, understood as ambiguity and especially vagueness.[9] Well, yes, completely agreed, except for the "just"! Characterization in terms of vagueness reformulates the problems, and usefully so, but does nothing to resolve them. We have no account of vagueness that succeeds in telling us how to make sense of "vague" extensions of vague predicates or, transposing to the formal mode, how to provide truth conditions for vague statements, such as characterizing an object as a chair. This is not the place to summarize the failings (with respect to the problems relevant here) of all extent accounts of vagueness.[10]

4 The Alternative to Referential Realism, Instrumentalism, Also Fails

If referential realism fails, presumably the alternative is instrumentalism. At least among other things, theory functions as a guide to what to expect by

way of the deliverances of perception. Instrumentalism, broadly conceived, is the view that the content of scientific theories is exhausted by such expectations. But instrumentalism has the presupposition that unaided perception does not have the failings that undermine referential realism for theoretical objects. We take ourselves plainly to see things around us—the objects of perception such as the Eiffel Tower, the standard kilogram, and the like. Likewise, we take ourselves plainly to see property instances that these objects of perception have: the pointer pointing to the numeral "5," the right side of the balance pan being lower than the left side, and the previously blue litmus paper now being red.

But instrumentalism fails. It fails because this presupposition fails, and for the same kind of reason that referential realism fails in the realm of the theoretical. The world is too complicated for perception to identify completely specific concrete objects of perception or the properties or characteristics that such objects of perception might have.

Starting with properties, I will illustrate with the well-known example of perception of colors. Naively, we take ourselves visually to detect colors of objects as intrinsic properties that they possess: the color of that scarf is bright red. Already in the early modern period it was appreciated that colors, and secondary qualities generally, are not intrinsic properties but a complex of the interaction between external objects and our perceptual systems. Today we know a great deal about the complexities of color vision. Our experience of things as colored is a complex process involving properties of the object perceived, the light reflected, extremely complex perceptual processing, and all kinds of environmental circumstances.[11]

What about primary qualities, shape, size, and duration? As noted by many from Berkeley onward and in the respects relevant here, primary qualities suffer vagaries similar to those suffered by the secondary qualities. A coin viewed from an angle casts an oval image on the retina but is still seen as round. All kinds of environmental clues (relative positions and sizes, textures, lighting, etc.) affect how we see relative locations, sizes, and shapes. Perceived temporal duration is highly context dependent, and for short intervals even perceived temporal ordering of events can be a construction of our perceptual processing.

Turning to objects, we take ourselves plainly to see objects in front of us: that stone, that tree, that chair, the standard kilogram bar, and so forth. But what is actually perceptually available to us? To illustrate, imagine you are driving toward the Eiffel Tower. You catch sight of it—you see the Eiffel Tower! But wait—a bit of the top is obscured by a cloud. And even with nothing obscuring your vision (from the visual perspective you hold) you only see one side of a limited number of parts of the tower. That you have seen (all, or even a part of) a completely specific referent of "the Eiffel Tower" looks to be some kind of inference—but, of course, no explicit conscious inference. Perceptual experience fills in enormously.[12]

What current perceptual science shows us is that our perceptual system puts together for us a visual experience as of some completely specific external object. Not only does the perceptual system fill in much detail with which we are not currently in visual contact, but just how we experience the target includes a great deal of tacit information about how the object would look from different angles, about the further experiences we would have were we to physically interact with the object, and so forth.[13]

How might we interpret these comments? Two alternatives are available. First, there is some completely specific referent of "the Eiffel Tower" and likewise for other perceived objects. Our perceptual system fashions for us a pretty detailed model of these objects, filling in a great deal that is not visually available. But owing to the complexity of things, these models are never in any sense complete and never, where they do specify, completely accurate. The second alternative is just like the first, but the assumed target of perception is problematized. The alternative I want to consider is not a modern referential idealism (or solipsism), that all we have are our perceptions and there is nothing otherwise independent of us. Rather this alternative agrees, to express it neutrally, that there are "Eiffel Tower phenomena," but the world is far too complex for there to be one specific referent of the phrase "the Eiffel Tower." Rather, thinking (and acting) in terms of a unique referent is a simplification, a kind of idealization, of a much more complex set of circumstances.

This second alternative should by now sound familiar. What's the argument for it in the case of objects of perception? As before, the problem is not that there are no candidate referents but that there are too many. Just what is to be included in the supposed specific referent of the first alternative? Spatially, there are so many specific physical objects that could be in question: With or without the concrete buttress holding up the legs? With or without bits of paint that have just about flaked off? With or without a bolt that has just come off? Just what gets included in the purported referent of "the Eiffel Tower"? For the standard kilogram bar, the problem is particularly acute. The bar is constantly losing and gaining tiny bits of matter, for example, when it is handled. Technicians struggle to take these into account, to get a stable standard for the kilogram, but never with complete success. Just what is the referent of "the standard kilogram bar"? Temporally, at just what point in time did the Eiffel Tower or the standard kilogram bar come into existence?

That there are specific objects of perception, referents for our terms for them, and properties that we take ourselves as perceiving them to have, are simplifying idealizations or models that nature puts together for us. The problem and the response to it are very much the same as for the purported referents of our theoretical terms. To provide an alternative to realism about theoretical objects, instrumentalism would have to be free of the difficulties for theoretical objects from which it was supposed to rescue us. But instrumentalism faces exactly the same underlying

difficulties. The world is too complicated for us to have any exact knowledge of it. At both the level of theory and the world of perception, we know the world though the inexact representations (call them models, idealized characterizations, perceptions, etc.) that we fashion or that nature fashions for us.

By this point we have a more detailed characterization of and argument for Giere's perspectivism, as applying not just to things postulated by our theories but also at the level of perception. All human knowledge is inexact. All human knowledge is perspectival in the sense that our representations are always fashioned within one or another inexact representational scheme. In the case of theory, we generally have a range of complementary theoretical perspectives. In the case of perception, for the most part we are built to work with the perceptual perspective that nature has fashioned for us, which is nonetheless a perspective because it is highly inexact. It is also shown to be a perspective, in the current sense, by the fact that we can complement it with one or another theoretical perspective that we use in the science of perception.

I need to make two qualifications to my claim that *all* human knowledge is from one or another inexact perspective. Combinatorial facts, logic, and in general, finite mathematics provide a most plausible systematic exception. But as soon as we get to mathematics where the incompleteness results show that there are unintended interpretations, we have difficulties analogous to those for empirical knowledge. Second, it is to be emphasized that the ubiquity of perspectivism is not a logical or conceptual fact about human knowledge. It is entirely contingent because of the complexity of the world compared to our meager human epistemic capacities, abundantly illustrated by examples that I have cited and innumerable ones similar to them. Because it is contingent, the conclusion is not that this is what human knowledge has to be. The world is changing so fast that I will not hazard how this all might look 100, 50, possibly even 20 years from now. Rather, I take my job as an interpreter of the human epistemic enterprise to characterize the nature of human knowledge as it now exists or will be as long as it faces anything like the limitations that now constrain it. But does the perspectivism that I have argued for properly count as some kind of realism?

5 How to Think About Realism

What are our options? Referential realism, or any view of which it is a necessary condition, fails. Instrumentalism fails. I won't discuss other historically discarded views: idealism, sense data theories, and so on. The problem is that we need a fresh alternative. Perspectivism provides such an alternative. Perspectival knowledge is the best, really the only knowledge (with the qualifications mentioned) humans can, in practice, have. We could let it go at that. The perspectivism that I have described isn't

referential realism. Legions of scientific realists have laid claim to the term "realism." Perspectivists could just let them have the term and move on. But it is also worth exploring why, just as Giere suggested, the label "realism" is appropriate for perspectivism.

To review, with just a little more detail, here is the earlier "generic" formulation of contemporary scientific realism, following Psillos (1999, xix) and Chakravartty (2017, sec. 1.2). First component: there is a mind-independent world that is the target of scientific (and perceptual) knowledge and understanding. Since most of what happens happens independently of what we think or wish, perspectivists eagerly embrace this assumption. Second component: scientific claims are to be taken literally, in particular as having truth values, and not to be reinterpreted as mere instruments for guiding our expectations about the perceptual. Since, as I have explained, instrumentalism is no rescue for the difficulties instrumentalists see in realism, perspectivists also enthusiastically endorse this condition. Third component: mature theories succeed in giving us true, or approximately true, statements about the world and the things in it. Scientific realists concede that, for the characterization of the properties of things, all scientific knowledge is, at best, "approximately true." But generally speaking, the position appears to be that, for much of mature science, the referential claims are true, full stop.[14] I have already detailed my reservations about referential success. In addition, we need some critical examination of how to understand "approximate truth."

The reservation about approximate truth is that it is context dependent and, in particular, interest dependent. This already follows from the circumstance that "approximate truth" is going to be a matter of degree. Close enough to the truth for what? That will depend on what our interests are, what is at stake. But the context dependence is much more pervasive.[15] To say that a false statement is approximately true comes to saying that what the statement describes is similar to what in fact obtains. But similarity is context dependent and, in particular, interest dependent. Any two things are similar in countless ways and dissimilar in countless others. To say similar without explicit qualification always has to be understood as similar in contextually determined respects and not in others. Given that approximate truth can be understood in terms of similarity between what is claimed in a statement and what a fully correct statement would present, approximate truth has the same contextuality that we see in claims of similarity. One and the same statement will be approximately true in some respects but not in others. Which respects are intended is usually set by context.

Acknowledging the contextuality of approximate truth has an unexpected implication: standard scientific realism is immediately transformed into a perspectivist view! If, like absolute truth, approximate truth were context independent, then one could say of an approximately true statement that it is approximately true for, well, for anything. But given that an

approximately true statement will be (a) close to the truth in some respects and not in others and (b) in those respects close enough for some things but not others, these context-dependent limitations constitute restrictions to perspectives in the sense developed in section 1. Specifying the respects and degrees already is robustly to characterize a perspective from which, or within which, a statement can be treated as true, a perspective from which claims cannot be exported.

Proper treatment of the existence claims of referential realism injects a second robust perspectivist component into standard scientific realism. For the existence claims themselves, "approximate truth" may seem to many a non-starter. What would it mean to say the claim that there are atoms is "approximately true"? Either there are atoms or there are not! I don't know of any explicit statement to this effect in the realism literature, but context often suggests that this attitude is being presupposed, perhaps as so obvious that it needs no mention. The one hedge I know in the literature is Psillos's statement: "[T]he entities posited by [mature, well confirmed theories], *or, at any rate, entities very similar to those posited*, do inhabit the world" (1999, xix, emphasis added).

How should we understand saying that entities of one kind are "very similar to" entities of another kind? If both kinds of entities exist, such claims are unproblematic (as long as we keep in mind the complication that two objects that are similar in some respects will always be dissimilar in others). But if there are no entities of the first kind, and this is because the term for the first kind hasn't been attached to an extension-determining characteristic, it is without content to say that entities of a second kind are similar to those of the first kind. No entities of the first kind have been specified. So there are no things of the first kind of which we can say that they share properties with entities of the second kind. The best we could say is that entities of the second kind have the (or many of the) properties that entities of the first kind were *supposed* to have. But then, why would they—namely, the entities of the second kind—not be the real entities of the first kind to begin with? So Psillos's hedge is empty. We need an alternative way of addressing the referential failure of standard scientific realism.

Though having rejected the existence claims of referential realism, I have also recognized the usefulness of the tools of reference by thinking of them as operating in idealized models (accounts, theories, etc.) where they function as if they had referents, and the models as a whole, in fortunate cases, function excellently in understanding one or another general aspect of how the world works. But understanding the function of the tools of reference as working through application in idealized models or idealization schemes is to characterize them as operating within the perspective characterized or created by those idealizations. The upshot is that, once the difficulties with both approximate truth and the referential component have been addressed, standard scientific realism *becomes* a perspectivist account.

Still, one could insist: so much the worse for realism of any kind for science. And, for those who have been persuaded by my arguments for the world of perception, so much the worse for realism for the objects of perception also. I think this would be hasty. While rejecting application of the designation "realism" in any absolute non-perspectival account, I will offer some considerations that support the appropriateness of using the term for the perspectival account I have sketched.

If we think of "realism" as denoting an attitude that takes imperfect representations nonetheless as telling us about the mind-independent world, this is an attitude that current scientific realists should endorse. By and large, "approximate truth" is good enough for realists to say that a theory is telling us a lot about how the world is and, one can add redundantly, how it is *really*. Let me offer a model, or parable, that supports this attitude.

Imagine a much simpler universe. You and I know every detail of what occurs in this world. Denizens of this world get a great deal pretty accurately, but they get nothing exactly right. They can give descriptions of how macroscopic objects are shaped but get some little details wrong. The small mistakes don't show that they have no grip on what such shapes *really* are, especially when the mistakes are, for their interests, inconsequential. Or consider a thermodynamic example. This world is composed of Democritean-like particles. There is no further analysis to be had of their constitution. These particles engage only in rectilinear motion that can change on collision. The creatures of this world postulate a quantity, temperature. They have thermodynamics but no statistical mechanics. We know that their temperature is mean translational kinetic energy for which there are fluctuation phenomena, but the world's denizens aren't aware of these fluctuations and incorrectly believe that there are none. Still, they know a lot about thermal phenomena. Their "temperature" is an idealized quantity that applies to their world only through their idealized thermodynamics. Still, these denizens know a lot about what is really going on in their world, especially if the fluctuation phenomena are inconsequential to them.[16]

I submit that such thinking shows "realism" to be a sensible label for "approximately true" qualitative claims, and if so, the label is sensibly extended to existential claims likewise. The barrier to so doing was worries about how to understand "approximate truth" for claims such as "things of kind x exist." But I have supplied a viable interpretation. To say that "things of kind x exist" is approximately true is to say that an idealized model that uses the tools of reference for things called "x" is successful for an important and broad range of applications.

I will develop two further ways to support the appropriateness of retaining the designations "real" and "realism." I suspect that a facet of the problems with the realism debate has been roughshod use of the word "real." In the first instance, "real" is used for the simple idea of reference. To say

that the Eiffel Tower is real is just to say that "the Eiffel Tower" has a referent. To say that Santa Claus is not real is just to say that "Santa Claus" has no referent. To say that "atoms are real" is just to say that "atom" has a non-empty extension. But then all sorts of more subtle but important uses and connotations of the word "real" are left by the wayside. Are chairs, clouds, rainbows, shadows, holes, mirages, and fairies real? There is a slide here, where there shouldn't be, if the world "real" is applied with the clear "all or nothing" presumption. No question: chairs are real. Clouds also, I should think. Are rainbows real? Any discomfort with saying that rainbows are real is that they are not real physical objects. You're in trouble if you go looking for the end of one. But rainbows are perfectly real optical phenomena. Similarly for shadows and holes. They are perfectly real, but one has to be careful what one means by such statements. (Real) shadows are relatively well-localized blocked light in an otherwise well-illuminated background. (Real) holes are the relatively well-localized absence of material in an otherwise solid medium. Turning to mirages, they, like rainbows, are perfectly real optical phenomena, but we also deny that they are real in the sense that there are no objects of which they are mirages. And things pretty well give out when we get to fairies.

The example of clouds nicely illustrates the way I want to think about how we use the tools of reference in a way that shows the foregoing slide to be unproblematic. We do use the tools of reference with clouds as referents and extensions. We talk about "the oval-shaped cloud" and "all the clouds in the sky at noon." And identity: "you and I are looking at the same cloud." But *of course* we have to take care with such usage. We use the tools of reference when the purported referents are "distinct enough." When clouds begin to merge such usage breaks down. Treating clouds as specific, distinct objects of reference is a simplification—an idealization, if you will. The "distinct enough" is easily understood as follows: this idealization is one that does not get us into trouble with our present practical aims. When our subject is clouds, the standards of care and the things that can go wrong are different from and much more demanding than the analogous standards of care when the subject is ordinary physical objects. When we get to optical phenomena, such as rainbows and mirages, we can still use the tools of reference, but with their own required standards of care. The standards of care are dependent on the kind of idealizations that are in question for these different subject matters—the idealizations that are needed to enable use of the tools of reference.

The moral is thus the following: scientific realists have proceeded as if concrete particulars and other purported referents, such as, perhaps, space-time points, property instances and the like, and their collections were all that is in question. But when using "real," one has to take care to be clear: real for what kind of things? Concrete particulars? Phenomena? Absence of light or material? And so on. Then we have to look at whether, or to what extent, treating the referent as real—more carefully,

using referential terms in the simplification—will work for us in the present practical context. It is the strategy of deploying the tools of reference, and other simplifications, in one or another broad idealizing scheme that Giere had in mind with his characterization of working within one or another perspective.

Let me provide a second consideration that illuminates this general moral. Readers who have followed me this far won't succumb to the following, but some already in section 4 will have had the following reaction: the author is arguing that there are no colors, rocks, chairs, cells, electrons, and so forth. This is just rank skepticism! Some of these critics may think that skepticism about cells and atoms is arguable, but hardly for colors and rocks.

But wait! Does sophistication about color perception amount to skepticism about colors? In a sense, yes. But such skepticism is utterly harmless. Once one sees that such skepticism about colors is innocuous, one quickly sees that the same goes for rocks and other macroscopic objects. One's mind is then opened to taking a similar approach to "unobservable" things such as cells and electrons, especially when one sees that instrumentalism provides no refuge.

To summarize the point: there is a kind of harmless skepticism that pervades the argument of this paper. But it is entirely mitigated once one takes a little care in how to understand the designation "real."

Interlocutors may object at this point: if we really are in a situation like that of the creatures of the world of my analogy, of course, the designation "realism" is well grounded. But take away what you and I know about in the story—"the way things *really* are, *exactly*"—and the analogy collapses. This worry gets my intent wrong. Nothing I have argued, claimed, or said involves or presupposes that there isn't some unique way things really are, exactly. "Things are what and the way they are and not some other way" is a truism to which I heartily subscribe. Perspectivism is a manifestation of our limited epistemic powers, relative to the overwhelming complexity of the world. With the qualifications mentioned above, exact human knowledge is utterly beyond our reach. We are always operating within some partial and not completely exact representational scheme. Different schemes attain their level of success differentially with different aspects of things. It is these representational schemes that correspond to what Giere had in mind by "perspectives." They are, in fortunate cases, immensely informative perspectives on the way things are. Add redundantly, if you like, the way things are *really*.

Notes

1. Throughout this chapter I use "idealization" very broadly for assumptions known to be false but advanced in the expectation that their errors will not interfere with the idealization's usefulness.
2. Except for entrenched instrumentalists, will any of us deny the truth of, for example, "water is H_2O"? The problem here is that both "water" and "is

H_2O" are imprecise or vague. The complexities of water chemistry show that as soon as the claim is sharpened up, it becomes false. See VandeWall (2007). This sort of complication applies broadly across the sciences. In Teller (2017), I work out in detail how such considerations impact claims of truth.

3. The referential component of scientific realism is often mentioned (e.g., Psillos 1999, xix; Chakravartty 2017, sec. 1.2; Laudan 1981, 33). There is also a critical literature (Hardin and Rosenberg 1982; Cruse and Papineau 2002; Newman 2005; Papineau 2010).
4. Does referential realism cover structural realism? I do not have the space to go into this issue in detail, but on the face of it, yes, since for a structural realist our theories must have terms interpretable as referring to the claimed structures.
5. Which I am told will have been kept and maintained after the new theoretical-based definition of the kilogram goes into effect sometime during 2019.
6. Occasionally critics demand argument that the world is indeed so complicated. Examples in this section and throughout the chapter will provide many illustrations.
7. While it requires more careful examination than I have so far given it, complications of electroweak theory also may throw extensions for elections and other leptons into doubt.
8. It is misleading to characterize such an approach as "fictional." That a description is partially in error does not make it a piece of fiction. Consider, for example, psychiatric case histories that falsify irrelevant personal details to preserve privacy. For a full discussion, see Teller (2009) and especially Winsberg (2009).
9. I have examined the interconnection between ambiguity and vagueness in this particular network of problems in Teller (2018a, 293–294). The well-understood phenomenon of ambiguity largely falls out of the discussion and I will focus on vagueness in the immediately following.
10. I have detailed some of these considerations in Teller (2018b). Also to be noted: since the problem I have described can be reformulated as problems of vagueness, the approach to addressing them, in terms of idealized descriptions, provides the seeds for an approach to vagueness that is entirely different from anything I know of in the literature. While I have not yet developed this idea in any detail, I have developed tools that I expect will be needed in Teller (2017).
11. For an accessible survey of the science, see Giere (2006, chap. 2). Chirimuuta (2015, chap. 4) gives a more detailed exposition.
12. Skeptics about what I am claiming here should see Churchland and Ramachandran (1998).
13. There are hundreds of research articles supporting these claims. Just three are Akselrod, Herzog, and Öğmen (2014); Churchland, Ramachandran, and Sejnowski (1994); and Churchland and Ramachandran (1998).
14. The references in note 3 above can be extensively extended.
15. The following is a rough and ready exposition to facilitate seeing what the problem is. A much more careful exposition is to be found in Teller (2001, 402–406). As explained there, the problem of similarity for approximate truth is the right interpretation of Miller's infamous "language dependence" problem.
16. In Teller (2018a), I show that *our* notion of temperature, and physical quantities very broadly, have exactly the idealized status illustrated in the foregoing analogy.

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